LESSON PLAN

Life in the Extreme

Craters of the Moon National Monument & Preserve

Three habitats: lava flow cracks, lava tube cave, cinder flat

GRADE LEVEL:

Fourth Grade-Twelfth Grade

SUBJECT:

Art, Biology: Animals, Biology: Plants, Botany, Climate, Climate Change, Earth Science, Environment, Geology, Hydrology, Landscapes, Mathematics, Physical Education, Physical Science, Science and Technology, Visual Arts, Volcanoes, Wildlife Biology, Writing

DURATION:

3-5 hours at the park for the site visit

GROUP SIZE:

Up to 36 (6-12 breakout groups)

SETTING:

in the park

NATIONAL/STATE STANDARDS:

Systems, Order & Organization
Concepts and Processes of Evidence
Technical Communication
Scientific Inquiry
Use Instruments to measure properties
Analyze & communicate adaptations of plants and animals

OVERVIEW

Students take measurements in the field, analyze their data, and develop hypotheses about how different micro-environments affect the distribution of plants and animals in the park. Students are also asked to communicate their understanding and attitudes about the park using graphics and language arts skills. (FIELD TRIP & CLASSROOM ACTIVITIES)

OBJECTIVE(S)

1. Engage in experiential learning.
2. Employ technology to make scientific measurements.
3. Formulate and test hypotheses and modify ideas based on observations and data.
4. Demonstrate creativity and communication skills using graphics and language arts.

BACKGROUND

Craters of the Moon is one of the harshest environments on earth! Summer air temperatures can exceed 100°F. Solar heating of the black rocks can produce surface temperatures in excess of 150°F. In addition, little moisture falls during the growing period and it is quickly absorbed by the porous rock. Winter can be -30°F and bring several feet of snow. Despite these extreme conditions, the park is home to a wide diversity of plant and animal species:

- >752 types of plants
- 61 mammal species
- >220 bird species
- 10 reptile species
- Thousands of different insect species

Experiencing, investigating and pondering how life survives and is interconnected with the physical environment should lead the students to the realization that even in an extreme environment, *life finds a way!*

How does geology affect life?

Cracks in the lava form a kind of micro-habitat that provides a number of advantages for living things, particularly here in the high desert.
Shade reduces solar heating, provides shelter from the wind, traps moisture (even ice!) and soil.

Wind-blown **soil,** or loess, provides an important growth medium for plants.

Solar Heating can lead to temperatures that exceed 150°F on the surface of the dark lava rock. High temperatures may cause animals to alter their active periods from daytime (diurnal) to twilight (crepuscular) or night time (nocturnal).

In summer, porous lava rock provides **insulation** and a cool refuge for heat-sensitive species like pika. In winter, temperatures beneath the lava and/or a thick blanket of snow provides the stable temperatures many animals need for hibernation (ex. bats, marmots and ground squirrels).
The lava rock provides **den and nest sites** for a variety of species. Bears have used lava tubes for den

sites. Marmots den in rocky areas and many of our lava tubes contain pack rat middens and nests. Some lava tubes and cliff faces provide nest sites for great horned owls, violet green swallows, ravens, mountain blue birds and prairie falcons.

A wide variety of other wildlife visit caves and waterholes in order to obtain **water** from melting ice.

MATERIALS
Equipment is available for loan from the park for use during your visit.

The equipment bag includes the following measurement tools :

- Anemometer (wind)
- Thermometer (temperature)
- light meter (light)
- carpenter's rule (distance)
- measuring tape (distance)
- hand lens (close up viewing)
- humidiguide (humidity)
- GPS (location)

In addition to this equipment students should utilize the Beaufort Wind Scale and Field Worksheets to estimate and record field data.

- **Beaufort Wind Scale**

Utilize this table to estimate wind speed at each site. Download

- **Field Worksheets**

Each worksheet provides instructions and tables for recording data, measurements and observations in the field. Download

PROCEDURE

PRE-VISIT

Attend a "Life in the Extreme" teachers' workshop. Click the link to find out when the next workshop will be offered.

(1) Utilize the "Life on the Lava" presentation to introduce the geology and the interaction of life with the geology, the extremes life must cope with, and adaptations that enable life to survive here.

(2) During their field trip students will visit three habitats: lava flow cracks, lava tube cave and a cinder flat. Follow links to display each habitat type in the classroom and ask students to formulate some questions or hypotheses they hope to answer or test during their visit to the three habitats, for example:

- *Which habitat supports the greatest diversity of life and why?* Students will find that Cinder gardens show the greatest diversity, largely because there is more soil (growth medium) and lose material like cinders that can be easily penetrated by plants to find nutrients and water. In turn the greater diversity of plants provides for a greater diversity of animal life. (Plant Life, Animal Life, Geology/Hydrology/Climate are all interrelated.)

- *Is there a good or poor relationship between crack width and crack depth on the lava flow visited?* The lava flow site visited does not show a good relationship between crack width and depth, but students should graph their data to find this out—see next question.

- *What would a good relationship between variables look like when they are graphed?* Each student group is going to make measurements of either three points along an individual long crack in the lava or from three different cracks in the lava flow habitat. Back in the classroom all the data from your groups should be plotted on a single graph. Either no relationship or a poor relationship between crack width and depth would produce a random pattern of points on the graph, while a good relationship would plot as an elongate cluster of points that a straight line could be drawn through. The area visited is going to produce a random pattern.

- *How will light, temperature, and humidity vary with crack depth or in a lava tube? Why? Examples: Heat rises/ cold air settles--- Are rocks still retaining solar heating? ---Are rocks insulating? --- Are cracks or caves breathing? ---Does sun light penetrate? ---Is wind blocked? ---Is condensation forming? ---Does it hold ice or water?* Observations and measurements as well as their educated guesses (hypotheses) or explanations will vary.

- *What adaptations allow plants and animals to survive here?* Plants are limited to physiological changes that assist survival, while animals because they can also change their behavior have both behavioral and physiological adaptations that aid survival. (e.g.: color influences how life absorbs or reflects light & heat or serves as camouflage; insulation—fat/coats/hair/feathers;

antifreeze; estivation & hibernation; migration/escape/elevation change; hardening; armor; etc.)

(3) During the field trip, students will be utilizing the Beaufort Wind Scale to estimate the wind speed. Prior to your visit it will be helpful to complete the following conversions.

- For a math exercise have students convert knots in the Beaufort Wind Scale to miles per hour; 1 knot = 1.15 mph.

- Students should make their own wind table on an index card using the "On Land" column. Mph, knots, or both units can be used. They should bring their wind scale card with them to use in the park. If the school has hand held anemometers students could couple wind measurements with the observed movement of additional objects/materials not found on the Beaufort Wind Scale and create their own observational wind scale, e.g., "The _____ HS Wind Scale".

(4) Contact park staff to arrange a date for a field trip to the park. This will ensure that equipment is available for your use and that a Park Ranger is available to assist.

VISIT

Upon arrival at the park check in with the Ranger at the visitor center and check out equipment for field measurements.

Students will visit, observe and measure features in three different park habitats:

1. lava flow with prominent cracks (East of North Crater Trailhead parking lot)
2. lava tube cave (Indian Tunnel)
3. cinder flat (west of Devil's Orchard parking lot)

At each habitat site complete the following Field Worksheets.

Wind Speed

This is the first activity/worksheet that will be completed at each habitat during your field trip. Students will make their own estimate of the wind speed at each site, followed by either the teacher or student measuring it with a park provided anemometer. Utilize a copy of the Beaufort Wind Scale for student observations.

Crack Habitat

Find three cracks or crack segments and measure the temperature using the laser thermometer at the surface and at depth. Use the light meter to measure the light in foot candles at the surface and at arm's length in the cracks. Measuring humidity at the surface and arm's length is optional. Record any plant or animal life seen. Measure the depth and width of each crack in centimeters. Utilize the fiberglass tapes to measure the depth of the crack and the carpenter's rule to measure the width. Record all data on the field worksheets.

Emphasize that scientists' tools or technology used from many different vintages can all yield valid data---Tools needed (carpenters rule—old technology; fiberglass measuring tape—current technology; laser thermometer—state of the art technology; light meter—long standing but current technology; humidity meter—dated/old technology). Younger students struggle with being patient enough to get an accurate humidity measurement, and is therefore listed as optional.

Nature: Look Closely

For hundreds of years the hand lens was the main tool used for enhanced observation by geologists, botanists, and zoologists and remains an important tool still used today. Have each student take a turn to examine a natural object with this traditional tool/scientific instrument. For younger students it may be their first journey into the "World of the Small". Emphasize that their descriptions, sketches, etc. need to be sufficient/robust enough for someone else to learn about or recognize the natural object they chose. Moss and the leaves of dwarf buckwheat are particularly interesting when viewed with a hand lens. The rocks are a good choice too.

Use Your Senses

Early scientists didn't have technology like electron microscopes, X-Ray or chemical analysis machines, and the like--- they basically had their senses with which to make observations and if they were lucky a

hand lens and binoculars or telescope. Making accurate, understandable, and reproducible descriptions of the natural world is a dying art and one that you and your students can help revive! For a minimum of two minutes in each habitat have students make observations with their physical senses (sight, hearing, feeling, and smell) with no fidgeting, no talking, no instruments, no working with papers, etc. After you tell them they can move and talk again have them record their observations on their field sheet. Did they feel the wind on their cheek or hear a bird, bee, insect, or squirrel? Did they smell the musky odor of pack rat droppings or the fragrance of a plant? Did they spot a chipmunk, marmot, or a red-tail hawk flying overhead? Was anything blooming, changing color, in fruit, or dropped its leaves? (Phenology)

Cave Habitat

A classic technique used by scientists is to measure variables along a transect. Follow instructions on the worksheet. Transects can be placed at random within the cave, or groups can do them sequentially making one long transect.

Location

The teacher will be provided with a GPS unit while in the park; to parallel park research, use the same datum the park uses, NAD83, and record positions using the UTM coordinate system. If students have their own GPS unit or a GPS App in their smart phone, they may want to record a track from the bus to the habitat site and record way points for key features or their measurement locations, etc. This will give the teacher more flexibility for back in the classroom for plotting or other activities.
Optional Location activities:
(A) Pick up enough park maps to have one in each group. Have students mark on the map where each of the 3 habitats is located. (B) Teacher is provided with a good compass for use in the park and a group of students could be assigned to take bearings to prominent features and use trig/geometry to plot the location of habitats on a map back at school—an old mapping technique. (Note--many students will also have a compass App in their smart phone.) (C) Draw a sketch map of site and show where/what vegetation is present or mark where photographs were taken of vegetation/features. (D) Sketch or draw life found and the physical features of the habitat. (E) Photograph comprehensively each habitat. (F) Write a physical description of the life observed and the geology present. (G) Use prose or poetry to describe each area.

POST-VISIT

Upon your return to the classroom we recommend the following activities:

Compare the Habitats
Introduce this activity by discussing with the class the following questions:

- *What life was found only in one of the three habitats - did you notice any?*
- *Were any plants or animals found in all three?*
- *Were some found in two habitats but not the third?*

Create a spreadsheet to compare plant and animal life observed in each habitat.
Examples of observations may include the following:
There were no trees in the lava tubes but they were present on the cinder flats and lava flow. Dwarf buckwheat plants were observed only on the cinder flats. Sulfur buckwheat plants were on both cinders and lava. Lichen was found on the lava flow rocks and in the lava tubes, but generally was absent on the cinders. Moss was found in all three habitats, but was not found where there was no light present.

Use Your Senses
As a group, compile a list of all the different observations that were made in the field utilizing the "Use Your Senses" worksheet. Tally the frequency of similar observations on the blackboard and/or have students use a computer to record and tally all the observations in a spread sheet. Compare number of observations made by each group, what group was the most observant (extra points?).

Communicate Your Findings
Posters may be displayed at your school or given to the park for display. These posters allow students to express their creativity and engage in communication of their understanding, feelings and emotions about the park. Park staff are proud to display your work at the visitor center but we have limited space. Due to this limitation, it is recommended that students work on the posters in small groups rather than individually.

ASSESSMENT

Formative Assessment: e.g. questioning and creation of student posters.
Summative Assessment: Students will be able to develop a conclusion(s) with supporting evidence to prove their thinking.

PARK CONNECTIONS

Actively engages students in seeing the interconnection between life and the physical environment of the park.

EXTENSIONS

Have students create, draw, and describe a make believe creature of their own design that they think would thrive here at Craters of the Moon. Name their creation and describe the special adaptations that allow it to survive in this extreme environment.

ADDITIONAL RESOURCES

Students may be interested in completing a *Citizen Science Booklet* with their families during subsequent visits to the park. This free activity book allows participants to conduct park resource observations and earn a sticker.

VOCABULARY

Adaptation, interrelationship, ecology, environment, cinder, lava, lava flow, rafted block, lava tube, solar heating, insulation, habitat, micro-habitat, volcanic glass, humidity, shelter, weathering, survival, hypothesis, transect, GPS